



3. Calculation of Specific Activity per Particle.

Vol of 1 micron ( $\mu$ ) particle =  $4 \times 10^{-12} \text{ cm}^3$

$1 \text{ yd}^3 = 8 \times 10^5 \text{ cm}^3$

$\therefore 1 \text{ yd}^3 = 2 \times 10^{17} \text{ } 1\mu \text{ particles}$

Total  $\beta$  activity at 24 hr =  $1.3 \times 10^7$  curies

$\text{Sr}^{89}$  (53 day half-life) =  $3 \times 10^4$  curies

$\text{Sr}^{90} - \gamma^{90}$  (25 yr half-life) =  $5 \times 10^3$  curies

	<u>Fireball</u>	<u>Crater</u>
Radius	= $\frac{15 \text{ feet}}$	$200 \text{ feet}$
Depth	(15) "	120 "
Vol of earth	$500 \text{ yd}^3$	$1.5 \times 10^5 \text{ yd}^3$
Total $1\mu$ particles	$10^{20}$	$3 \times 10^{22}$
Total $\beta$ activity per $1\mu$ particle	$1.3 \times 10^{-13}$ curies	$4 \times 10^{-16}$ curies
$\text{Sr}^{89}$ activity per $1\mu$ particle	$3 \times 10^{-16}$ curies	$1 \times 10^{-18}$ curies
$\text{Sr}^{90} - \gamma^{90}$ " " " "	$5 \times 10^{-17}$ curies	$2 \times 10^{-19}$ curies

For  $10\mu$  particle activity will be  $10^3$  times greater than for 1 micron particle

For  $100\mu$  particle activity will be  $10^6$  times greater than for 1 micron particle

CALCULATION OF HAZARDS FROM SURFACE OR UNDERGROUND DETONATIONS

Assumptions for Worst Possible Situation:

- a. All radioactive material stays in cloud and none is deposited in or around crater.
- b. Cloud moves along ground and does not lift.
- c. Cloud spread and rise minimized.

1 KT U-235 Bomb; Wind 10 mi/hr or less; inhalation rate 10 m<sup>3</sup> / 8 hrs (20L/min.)

Time hrs	Total $\gamma$ Curies	Total $\beta$ Curies	Sr <sup>89</sup> Curies		Sr <sup>90</sup> Curies		dia. mi.	Cloud		Transit Time min.	Maximum Distance Traveled mi.	Amount Inhaled Liter	Concentration (Curies/liter)		
			Inhaled	(53 d)	Inhaled	(25 y)		thickness mi.	Volume mi. <sup>3</sup>				Volume liters	Sr <sup>89</sup>	Sr <sup>90</sup>
1	30x10 <sup>7</sup>	60x10 <sup>7</sup>	3x10 <sup>4</sup>	5x10 <sup>3</sup>	2	1/5	0.6	3x10 <sup>12</sup>	12	30	240	5x10 <sup>-5</sup>	1x10 <sup>-8</sup>	2x10 <sup>-8</sup>	3x10 <sup>-5</sup>
3	8x10 <sup>7</sup>	16x10 <sup>7</sup>	3x10 <sup>4</sup>	5x10 <sup>3</sup>	3	1/5	1.4	6x10 <sup>12</sup>	18	60	360	1x10 <sup>-5</sup>	5x10 <sup>-9</sup>	1x10 <sup>-9</sup>	5x10 <sup>-6</sup>
6	3.5x10 <sup>7</sup>	7x10 <sup>7</sup>	3x10 <sup>4</sup>	5x10 <sup>3</sup>	6	2/5	11	50x10 <sup>12</sup>	36	120	720	6x10 <sup>-7</sup>	6x10 <sup>-10</sup>	1x10 <sup>-10</sup>	3x10 <sup>-7</sup>
12	1.5x10 <sup>7</sup>	3x10 <sup>7</sup>	3x10 <sup>4</sup>	5x10 <sup>3</sup>	10	1/2	40	200x10 <sup>12</sup>	60	240	1200	7x10 <sup>-8</sup>	2x10 <sup>-10</sup>	3x10 <sup>-10</sup>	4x10 <sup>-7</sup>
24	0.7x10 <sup>7</sup>	1.3x10 <sup>7</sup>	3x10 <sup>4</sup>	5x10 <sup>3</sup>											

$\gamma$ -intensity (r/hr) I c = 3x10<sup>5</sup> Conc in  $\gamma$  curies/liter

Time hrs	Total Curies		Sr <sup>89</sup> Curies		Sr <sup>90</sup> Curies		External Dose r
	Inhaled	Absorbed	Inhaled	Absorbed	Inhaled	Absorbed	
3	1.2x10 <sup>-2</sup>	1.2x10 <sup>-3</sup>	2.4	0.02	0.5	0.005	9
6	4.2x10 <sup>-3</sup>	3.6x10 <sup>-4</sup>	1.8	0.018	0.36	0.0036	1.5
12	4.3x10 <sup>-4</sup>	4.3x10 <sup>-5</sup>	0.4	0.004	0.07	0.0007	0.09
24	8x10 <sup>-5</sup>	8x10 <sup>-6</sup>	0.24	0.0024	0.04	0.0004	0.012

Tolerances - Chalk River Conference

1% of inhaled Sr <sup>90</sup> -  $\gamma$  is absorbed

Same for Sr <sup>89</sup>

Sr <sup>89</sup> - 1  $\mu$ C absorbed in body

Sr <sup>90</sup> - 0.5  $\mu$ C absorbed in body